BURROWING HABITS OF *ORNITHORHYNCHUS*.

By Harry Burrell, C.M.Z.S.

[Read 27th May, 1925.]

The only published observations of the burrowing of *Ornithorhynchus* are those of the French naturalist-voyager, Jules Verreaux (Observations sur l'Ornithorhynque, *Rev. Zool.* xi, 1848, 127), who spent some time in Tasmania, and claimed to have studied the habits of the animal closely. Unfortunately, Verreaux's account contains so many statements which are not borne out by my subsequent observations that I cannot but regard the whole of it with suspicion.

The interest attaching to precise observations of the actual burrowing method is considerable, the chief point of interest being to determine the relative extent to which the highly sensitive muzzle and the powerful claws of the pes are used in the process. The present observations were made during March of this year upon a single female animal which I had in captivity at my residence in Kensington. The creature was placed in a specially contrived enclosure, the essential features of which were a plate glass front and a wooden back, which were four inches apart at the bottom, widening to six inches at the top, filled with sifted soil, which was put in a bucketful at a time, each bucket of soil being followed by a bucket of water, until the frame was full, when the whole was tamped and thoroughly flooded with water. The object of the taper was to cause the soil to wedge, and so prevent its collapsing on the burrowing animal. Water was used to consolidate the soil to something like the consistency of the banks in which the platypus burrows naturally in the wild state. The enclosure thus prepared was allowed to stand for twenty-four hours, and the animal was then introduced at one side, where a portion of the earth was removed to make room for it, at 2 p.m. No attempt was made to burrow until about 5.30 p.m., but I am not certain whether this time bears any relation to what normally happens. It may be, however, that the animal normally commences its burrowing in the late afternoon. The observations which follow were made during a period of about an hour, by means of the plate glass front, and during this time I kept myself concealed as far as possible from the animal, so as to leave her undisturbed.

The Platypus, in order to obtain the greatest purchase before commencing to burrow, tucks the tapering end of its pliable tail between its hind legs, and, simultaneously, hooks its out-turned hind claws into the earth at either side. While in this crouching attitude, with stiffened top lip and splayed fore-claws, it proceeds smartly to break away the earth, selecting the softest spot available. After burrowing for several inches the animal rests awhile; then it energetically contorts its neck and body systematically, so as to tamp the freshly loosened earth tightly into the otherwise over-large hollow.

While stationary, the creature occasionally beats the surrounding walls with its trowel-like tail. But whether that action is really intended as an auxiliary to

the tamping process, or is simply due to the strenuous exertion of the entire muscular system, or both, I do not profess to know. Nevertheless, it certainly does not distort or tend to break away the true design of a finished burrow by its spasmodic action. In fact, according to the structure and shape of the tail, which, in cross-section, is a miniature replica of that of the tunnel, it could not possibly do so by normal means. Therefore, I suggest that, designedly or otherwise, the tail must be regarded as an actual modelling tool.

After a considerable spell, accompanied by laboured breathing and an occasional gulp in the throat, the operator again deliberately shovels the earth over its head with the end of its sensitive snout. In this way it creates a crude cavity in which to loll its head to one side, while, with the neck fore-shortened, it reaches to the utmost extent of its web-palmed paw, and scratches a hemispherical hollow to one side of the tunnel, contorting its shoulders the while. The energetic digger places its head in the recess so made, and, without any hesitation, performs a similar operation on the opposite side with the other splayed paw. Then, to dislodge the partition separating the two hemispherical recesses which is as yet untouched by the laterally working paws, it probes its muzzle vigorously into that section, thereby completing the circle, and furthermore, creating, as far as the out-stretched neck will permit, another "loll-hole" to one side with its muzzle, in readiness for its head in the shift to follow. Meanwhile, the well-worked earth trickles around the wriggling creature's body, principally about the powerful shoulders, whence a portion eventually filters down as far as the hips.

While the fore-paws and rooting muzzle are working at high tension, the hind legs are, alternately, keeping the specialized fore-parts well up to their work by clinging tenaciously to the solid earth. In their struggle to do this, the hind claws actually aid the process of excavation by cutting the lateral angles which complete the arched design of the burrow.

When the soil so worked has been reduced to tamping consistency, in order to distribute the load, the creature backs down the tunnel to the section previously completed. In so doing, it contorts its entire body, and if hard pressed, spirally so, until the superfluous soil adheres firmly to the hitherto somewhat irregular, roughly cut arch and runway.

Another well-earned rest follows, after which the Platypus again forges ahead, to repeat the burrowing manoeuvrings in their every particular, section after section, until the subway winding from porch to terminal cavity becomes a perfectly-modelled, accomplished fact.

When the animal is confronted with temporary obstacles, such as impoverished, caked earth between roots of trees, etc., in order to avoid retracing its steps to branch off in another direction it will, miner-like, follow the line, not of least resistance, but of favourable soil, even though it be compelled to *work on its back to do so*. The reason it occasionally adopts this upside-down attitude, or any other position, is so that it may dislodge the hitherto unforeseen obstruction by the most serviceable and powerful means, its versatile paws.

Such actions I have critically observed while the creature was manoeuvring in a tight position—this even in the absence of greater obstructions than are occasionally met with, and usually overcome, when a pregnant Platypus is riveting her whole attention on river bank burrowing.

Although it is customary for *Ornithorhynchus* to burrow in a normal position, lying on its back or on either side does not impede its progress in the least. In fact, it seems, at times, to prefer to work in spiral fashion, both while excavat-

ing and tamping its tunnel; but eventually it reverts to the normal attitude to model, accurately, its handicraft. The backward and forward progression of a burrowing Platypus while engaged in tamping is accomplished in separate sections of, approximately, six inches at a time—similar to the sections of pug tamped into position by the tail, prior to the brooding session. But it is not always accomplished in the aforesaid two "mobile" movements. Sometimes, according to the consistency of the soil, the creature will, again and again, repeat the process before relinquishing its arduous duties. Platypus work with a system, entailing detail in every particular.

The reversible action of the animal merits some remarks, especially the backward progression. Students of anatomy will have observed, no doubt, that the hind feet of a Platypus have a tendency to turn outwards from the flanks, and that the grooved, curved claws continue in that symmetrical trend towards the tail. This is as it should be for the purpose of gripping and scratching back surplus soil while the creature is tunnelling ahead. It is also as it should be when the creature reverses. Especially is this so when the animal is burdened with a packing of adhesive pug, and, incidentally, has the auxiliary agency of the front paws practically out of action. Admittedly, the muscular movements of the body at that time afford great assistance. Nevertheless, the hind quarters and cumbersome tail would become useless, if not a burden to the Platypus, during one of its essential functions but for the natural provision of a "two-way" action of the hind limbs. Preparatory to pulling backwards, the trend of the hind feet continues until the sets of claws are facing one another beneath the tail. This stance enables the contortionist to take a firm grip of the flattened earth-floor, so that it can pull the body backwards step by step, while the fore-paws, when freed, do the shoving. Just as the front limbs act alternately in advancing, so do the hind limbs advance in the reverse, and *vice versa*. It is rather amusing to witness this act, for, at the outset, the fore-parts are usually obliterated with pug, and the tail, which in contour and elevation somewhat resembles the head, puts one at a loss to guess whether the creature is really coming or going.

Apart from the claws, the hind foot of *Ornithorhynchus*, especially that of a male, is just as versatile in its actions as that of a chimpanzee, even to the power of deliberately gripping. And this apart from the versatility of the combined actions of the entire limb, which during a backward march resembles, in action and general appearance, the fore-limb of a grizzly bear, or, better still, that of a long-clawed sloth.

The transformation of the *pes* to *manus*, and *vice versa*, is rather deceptive, but readily acquired. Is this not a reptilian trait? What other mammal in the world is able thus to interchange the functions of its hind and front legs to such advantage? It may be characteristic of moles, etc., but it is certainly a remarkable transformation.

So much for the hind limb at present. Now I wish to record further data in connection with the shovelling snout of *Ornithorhynchus*, including the sensitive upper lip.

At the outset of this paper, I unhesitatingly referred to the latter functioning organ as a stiffened upper lip, but not without reason and due consideration. When one handles the foremost part of that lip, it would appear to be almost as limp as its counter-parts. But when the animal is putting it to practical use, viz., rooting into the earth, the position is different. Quite apart from the resiliency of its nature, or whether the creature has the power of temporarily stiffening that

section of its lip at will or not, the solid earth into which it is thrust prevents the lip from falling. At the same time, the lift of the snout arrests any other divergence until the bony prong of the bill is sufficiently embedded in the grooved earth to lever or root the load away. The groove referred to has previously been created, or "lipped in," by a very vigorous oscillation of the animal's head.

During the excavation of a complete burrow of any length, including all cavities, no superfluous earth whatever is ejected. Even the slight disturbance at the initial opening is tramped beyond all recognition as the animal continues to tunnel.

Given favourable conditions, a Platypus can excavate a cavity, approximately $5 \times 5 \times 6$ inches, in five minutes. It can tamp loosened earth, completely, into a six inch section of a tunnel in fifteen minutes. This makes twenty minutes in all to a shift. Therefore, if the tunneller continued unceasingly in this manner, in sixteen hours it would have completed a tunnel twenty-four feet in length. This is the average length of a breeding burrow.

The normal breathing of a Platypus, while asleep, I found to be fifteen respirations to the minute. That of the same healthy specimen, while tunnelling, was thirty to the minute, varied by conspicuous spasmodic gulps in the throat at approximate intervals of twenty-five seconds.

The facial furrows (embracing the orifices of the eyes and ears) are closed throughout the entire proceedings, as is the case when the Platypus is under water.